

PATENT SPECIFICATION

1,121,821

DRAWINGS ATTACHED.

Rec'd PCI/PTO

25 AUG 2005

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1,121,821



Date of filing Complete Specification: 14 March, 1967.

Application Date: 14 March, 1966. No. 11101/66.

Complete Specification Published: 31 July, 1968.

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Index at Acceptance:—B7 K; B7 V53B.

Int. Cl.:—B 63 h 11/08.

COMPLETE SPECIFICATION.

Improvements to Water Propulsion Systems Employing Fully or Partially Ducted Impellers.

We, HOVERMARINE LIMITED, a company organised under the laws of Great Britain, of Sardinia House, 52 Lincoln's Inn Fields London, W.C.2, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to water propulsion systems for water borne craft especially air-cushion craft.

If water propulsion systems are used for air-cushion craft the propeller must be arranged such that it is not damaged by obstacles on or near the surface of the water or by contact with any ground surface over which the craft is likely to travel. A form of protection commonly employed is the housing of the propeller in a duct or tunnel but this has several disadvantages. Firstly the ram effect of the free stream velocity is largely lost, but more importantly energy losses occur due to the formation of eddies in the duct at its inlet end because of the separation of the water flow from the upper surface of the duct. These eddies give rise to cavitation and this results in an uneven pattern of water flow to the propeller and reduces the propeller efficiency.

According to this invention there is provided a water propulsion system for a craft, the system comprising an impeller mounted for rotation in a duct or tunnel having an inlet which, in operation is disposed beneath the water over which the craft travels, and deflecting means located adjacent the inlet and formed so as to divert water into the duct or tunnel, the deflecting means being collapsible towards the craft on encountering an obstruction in the water.

[Price 4s. 6d.]

Preferably the deflecting means comprises a rigid grid formed with a plurality of horizontal vanes projecting upwardly and rearwardly therefrom.

The invention is diagrammatically illustrated in the accompanying drawings in which:—

Figures 1 and 2 are respectively longitudinal and transverse sectional views of a water-borne craft having a ducted impeller fitted with water deflecting means in accordance with the invention.

Figure 3 is a view corresponding to Figure 1 but showing the deflecting means in a collapsed position.

Figure 4 is a side view of another embodiment and,

Figure 5 is a transverse section on the line V V of Figure 4.

In the drawings the hull of the craft is indicated generally at C and built into the stern is a tunnel or duct D housing a propeller shaft and propeller P. R is a rudder. It should be understood that one or more impellers may be fitted to the shaft and likewise the craft may incorporate more than one duct with an impeller or impellers therein.

In such arrangements the inlet end indicated at 1 to the duct D lies flush or substantially flush with the bottom of the craft and while this has the advantage that it enables the draught to be reduced it results in an appreciable energy loss at the inlet due to the turbulence in the duct arising from separation of the waterflow from the convex upper surface 2 of the duct D as indicated in dashed line Y (Figure 1).

Referring to Figures 1—3 there is provided, according to this invention, a deflecting device depending from the bottom of

the craft and indicated generally at 3. The device, formed as a hood or scoop, has the shape of a part frustum and is arranged with its curved portion 4 facing downwardly and with a generally semicircular end face forming the inlet to the device.

The end face is formed as a rigid grid 5 of mesh material having an outer metal frame and is pivotally attached at 6 to the bottom of the craft. Curved portion 4 is formed partially or wholly of flexible material and is secured to grid 5 and to the bottom of the craft.

Means (not shown) may be provided so that the grid can be fixedly secured in a retracted position, in the event of the craft having to be navigated through shallow waters, or in a lowered or operative position where its inlet end lies across the stream so that as indicated by the arrow X water will be directed into the duct D thus preventing flow separation as mentioned above. When in its operative position the device may also be arranged to hang freely so as to be retractable in the event of it encountering a submerged object (Figure 3).

In the embodiment shown in Figures 1 and 3 the wall 4 is formed wholly of flexible material such as a synthetic rubber or a suitable synthetic plastics material but an arrangement can also be used where hoops of rigid material alternate with flexible material to allow collapse or retraction of the device. In operation the scoop maintains its shape due to the pressure of the water flowing therethrough but on encountering an object it folds up concertina fashion as indicated in Figure 3.

The fixing means may take several forms and is preferably so arranged that it can be rendered inoperative in which case the grid is biased towards its lowered, operative, position by means of a spring 7 so that any pivotal movement in a direction anticlockwise about its fulcrum 6 will be against the return action of the spring.

Vanes 8 extend horizontally across grid 5 and project rearwardly into the interior of the device 3. These vanes serve to direct the flow of water in an upward and rearward direction and assist in the prevention of flow separation from duct surface 2.

Figures 4 and 5 illustrate an alternative embodiment of the invention wherein the propeller P is housed in a tunnel T which is open throughout its entire length. Such a system is sometimes referred to as a tunnelled propeller and suffers from energy losses at the uppermost surface of the tunnel due to flow separation and also to energy losses due to the inflow of air. Such an inflow occurs for example when the craft is heeling during a turning manoeuvre.

In the present arrangement guard blades serving as keel members 10 are fitted to the

underside of the hull for folding movements about fore and aft axes 11, the members 10 operating to increase the flow of water along the tunnel T, and thus into the mouth of the impeller, when the craft is under way. The keel members 10 also tend to prevent the ingress of air into the tunnel T when the craft executes a turn thus maintaining efficient operation of the propeller.

Means (not shown) are provided for fixedly securing the members in an operative or inoperative position and the members can also be arranged to hang freely so as to be upwardly and outwardly retractable on contact with an obstruction.

A spring 12 biasing each of the members into an operative position is provided to ensure that upon the fixing means being rendered inoperative or subsequent to the members being retracted they return to an operative position.

Cooperating with the members 10 is a forward grid 13 capable of pivotal movements about a transverse axis 14 and operating in a manner similar to the grid shown in Figure 1 in that it is capable of being withdrawn into the tunnel T. Grid 13 is also provided with vanes 15 in order to prevent flow separation in the tunnel T and also to allow a greater utilisation of the ram pressures available due to the free stream velocity relative to the craft.

Flexible units such as those described can collapse on impact with debris and prevent the entry of foreign matter into the inlet channel and being retracted and stowed flush with the bottom of the hull also allow the craft to rest on its hull bottom.

WHAT WE CLAIM IS:—

1. A water propulsion system for a craft, the system comprising an impeller mounted for rotation in a propeller duct or tunnel having an inlet, which, in operation of the craft is disposed beneath the water over which the craft travels, and deflecting means located adjacent the inlet and formed so as to divert water into the duct or tunnel, the deflecting means being collapsible towards the craft on encountering an obstruction in the water.

2. A system as claimed in claim 1, wherein the deflecting means comprises a rigid grid formed with a plurality of horizontally extending vanes which project upwardly and rearwardly from the grid.

3. A system as claimed in claim 2 wherein the grid is pivotally suspended from the bottom of the craft so as to permit of displacement on encountering an obstruction.

4. A system as claimed in either one of claims 2 and 3 wherein means is provided for securing the grid in its operative position.

5. A system as claimed in either one of

- claims 3 and 4, in which displacement of the grid is against the action of a return spring.
- 5 6. A system as claimed in any of claims 3 to 5 wherein the deflecting means also includes a hood or scoop device.
- 10 7. A system as claimed in either one of claims 5 and 6, wherein the hood or scoop device comprises hoops or rigid material alternating with flexible material to permit of collapse to a flat position.
- 15 8. A system as claimed in any one of claims 5 to 7, in which the scoop device when displaced is housed within the propeller duct.
- 20 9. A system as claimed in any one of claims 1 to 5, comprising a propeller housed in a tunnel in which keel members are supported along each side of the tunnel so as to project downwardly therefrom, the members being retractably mounted so as to allow upward and outward displacement.
10. A system as claimed in claim 9, wherein means are provided to secure the members in an operative position. 25
11. A system as claimed in either one of claims 9 and 10, wherein displacement of the members is against the action of a return spring.
12. A water propulsion system substantially as described and with reference to Figures 1 to 3, or Figures 4 and 5 of the accompanying drawings. 30
13. A craft when provided with a water propulsion system as claimed in any of the preceding claims. 35

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Printed for Her Majesty's Stationery Office by Burgess & Son (Abingdon), Ltd.—1968.
Published at The Patent Office, 25 Southampton Buildings, London, W.C.2,
from which copies may be obtained.

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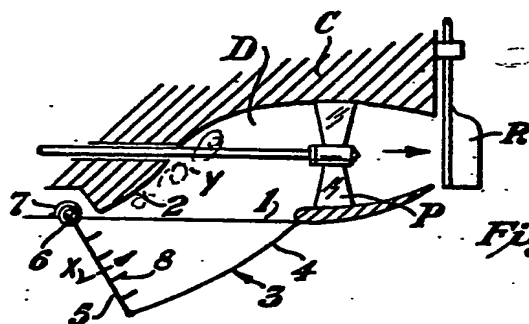


Fig.1.



Fig. 2.

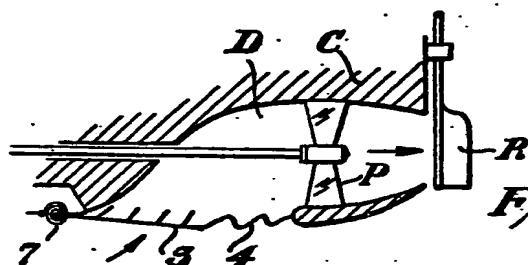


Fig. 3.

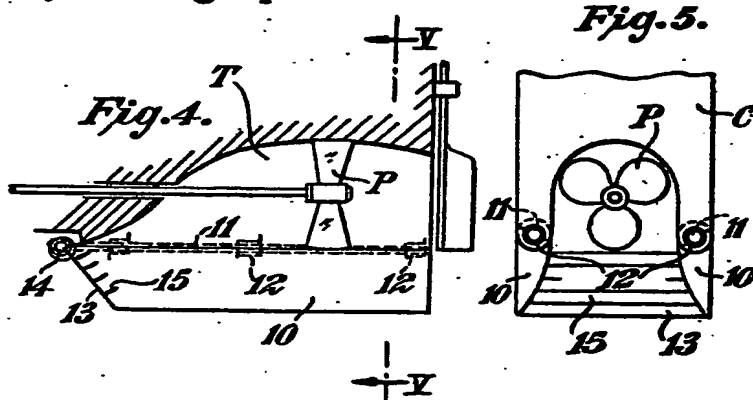


Fig. 5.

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